MONROE ELECTRONICS, INC. 100 Housel Ave. Lyndonville, N. Y. 1409

MANUFACTURERS OF ELECTRONIC INSTRUMENTS AND SYSTEMS

Area Code 716 765-2254
Telex 91-9188

# Instruction Manual For

# MODEL 230B

# STAT-ARC

# Static Electricity

# Detector/Monitor

Monroe Electronics, Inc.

100 Housel Avenue

Lyndonville, New York 14098

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# WARRANTY

Monroe Electronics, Inc. warrants each instrument and sub-assembly manufactured by them to be free from defects in material and workmanship for a period of one year after delivery to the original purchaser.

Liability under this warranty is limited to servicing, adjusting or replacement of defective parts (other than tubes, fuses or batteries) on any instrument returned to the factory for this purpose, transportation charges prepaid.

This warranty does not apply to products subjected to unauthorized repair or modification.

Before returning an instrument to the factory for any reason, notify us of the difficulty encountered; also the model and serial number of the instrument. We will furnish you with service and shipping instructions.

For warranty service in Europe, please direct all inquiries to:

MEM
Postfach 1520
8090 Wasserburg
Germany
Phone - 08071/8143

MONROE ELECTRONICS, INC.
100 Housel Avenue
Lyndonville, New York 14098

11/77

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## Section I

## APPLICATIONS/FEATURES

A. Applications:

- - Trouble Shooting Static Problems On Production Lines
- - Safety Monitoring
- - Checking High Voltage D.C. Terminals

B. Features- Meter:

- - Ruggedly Built For Industrial Use
- - Uses Readily Available Batteries
- - All Solid State Integrated Circuit Construction
- - Non-Radioactive
- - Stable Operation For Continuous Monitoring
- - Recorder Output
- - Wide Range - to 100KV

C. Features - Probe:

- - Small Extendable Probe Can Be Located Up To 28" Away From Meter
- - Permits Measurements Of Otherwise Inaccessible Surfaces
- - May Be Mounted On Operating Machinery And Monitored Remotely For Safety

## Section II

## SPECIFICATIONS

A. Range:

Full Scale range is dependent on probe-to-surface distance. Three meter ranges are provided with full scale ranges as follows:

Probe-To-Surface Distance

| | on "X 1" Range | on "x 3" Range | on "X 10" Range |
|---|---|---|---|
| @ 1" | 0 to ±500V | 0 to ±1500V | 0 to ±5000V |
| @ 12" | 0 to ±1500V | 0 to ±4500V | 0 to ±15000V |

An additional "X 10" range expansion is available with use of a special "snap-on" clip which attaches to the probe. This provides a full scale range of up to 150,000 V at 12" probe-to-surface spacing.

B. Sensitivity:

50 Volts at 1" probe-to-surface spacing

C. Static Accuracy:

Better than 5%

D. Drift:

Less than 50 Volts per hour at 1" probe-to-surface spacing, (non-cumulative under clean operating conditions)

E. Speed-Of-Response:

Less than 1/2 second after 10 second warm-up

F. Recorder Output:

Dependent on probe-to-surface spacing:

| Probe-To-Surface Spacing | Volts out per KV |
|---|---|
| 1" | 1.00 |
| 12" | 0.33 |

When the special "snap-on" clip is used, the recorder output is 1/10 of the values given above.

Recorder output load - 10Ω minimum

Recorder output connector - G.C. Electronics F2-820 or F2-821

G. Probe Dimensions:

1 5/8" maximum diameter x 1 5/8" long. Coiled probe cable extends to 28" from meter housing.

H. Size and Weight:

9 1/4" maximum length x 7 3/8" maximum height x 3 1/4" maximum breadth. 2 lbs 13 oz. Aluminum casting.

## Section III

## OPERATION

### A. Probe Mounting:

As supplied, the probe of the Model 230B is mounted in the barrel of the meter housing, and the instrument may be used by pointing the probe at the surface to be measured as though it were a pistol. It is desirable for accurate measurements to keep the surface of the probe parallel with the surface to be measured.

For many applications, it will be desirable to use the small probe remote from the meter. It can be removed from the meter housing barrel by twisting it approximately 1/8 turn counter-clockwise (as far as it will go) and pulling it out. The coiled cable to which it is attached will extend to over 28" from the meter housing. When replacing the probe in the barrel, wind the cable slightly so that its tension will hold the probe in its socket.

IMPORTANT NOTES:

1. The probe should always be handled and mounted by the unplated plastic part. The gold plated metal parts are not at ground potential and should not be permitted to come into contact with anything conductive (including fingers) during operation of the instrument.

2. For best results, the instrument should be zeroed with the probe in the position in which it will be used.

### B. Grounding:

For best operation, the Model 230B should be grounded during use. This is accomplished by connecting a clip lead between the grounding lug provided on the instrument and any convenient metal object terminated in Earth, e.g., water pipes, most metal parts of buildings, etc.

### C. On/Off/Range Switch:

A four position "power/range" switch is used to turn the instrument ON. When the instrument is ON an audible tone can be heard from the probe.

NOTE:

Since the instrument uses little power, and since it does have a 10 second warm-up, it is generally all right to leave it ON between measurements if many measurements are to be made within a short period of time.

D. Zero Control:

The zero control is provided to null the effect of varying ambient conditions, probe cleanliness, battery condition, etc. The control has a wide range and is stable with time after instrument warm-up.

E. Meter Calibration:

The instrument is calibrated in volts of surface potential for a given spacing between the probe and the surface being measured. The meter is provided with two separate scales which read directly in surface voltage for 1" and 12" probe-to-surface. Accurate measurements of surface voltages are most easily made with the probe at one of these distances. Additionally, for best accuracy, the surface to be measured should be at least six times as large in its minimum dimension as the probe-to-surface distance used. Appendix I provides calibration curves which permit use of the Model 230B at other probe-to-surface distances and other aspect ratios, e.g. the ratio of the size of the surface being measured to the probe-to-surface distance.

NOTES:

1. Factory Calibration is with the probe suspended in front of a large metal plate at 1" probe-to-surface spacing. The presence of the meter and fixtures or a hand holding the probe will alter the calibration since it distorts the electric field.

2. The Model 230B will read less voltage than actually present if:

   a. Any large grounded conductive object (roller, etc.) is less than several times as far away as the probe-to-surface spacing used. This includes the meter itself and the person holding the meter as well as metal rollers, etc.

      It is best to calibrate the meter for the specific application.

   b. If the surface is less than six times probe-to-surface spacing

F. Recorder Output:

The recorder output is provided to allow continuous monitoring of static charge accumulation using the Model 230B STAT-ARC. Recorder output voltage per kilovolt of surface potential is dependent on probe-to-surface distance, and is specified at 1" and 12" distances assuming aspect ratios of at least 6 to 1. Calibration at other distances or aspect ratios may be accomplished by referencing the curves in Appendix I.

NOTE: It is necessary to use a recorder with an input resistance of at least 10,000 ohms to prevent loading of the output circuitry. Maximum instrument output voltage is 5 Volts.

G. Batteries:

1. Test:

Battery testing is accomplished by depressing the + and - pushbuttons located on the instrument panel. The instrument should be OFF. When a button is pressed, the meter should deflect past the red dot, or past 350V on the 1" scale. If either battery does not check "OK", replace both.

2. Battery Replacement:

The screw in the bottom of the handle of the instrument must first be removed. The plug in the handle may now be removed by pushing it out using a pointed object inserted through the screw hole. The batteries may now be pulled out of the handle, unclipped from their holder, and replaced.

NOTE:

Battery types Eveready No. 216, Burgess No. 2V6, or equivalent 9V battery may be used.

3. Life:

Battery life should exceed 8 hours of continuous use; or many more hours of intermittent operation.

H. Snap-on "X 10" Clip:

This clip, furnished with each Model 230B, is an accessory designed to decrease the sensitivity of the instrument and thus increase its range by a factor of 10.

CAUTION:

At 1" spacing, this clip extends the range of the instrument to 50 KV/in at which spacing, breakdown of air is likely to occur causing a potential hazard to the instrument and operator.

Conditions for its use, therefore, should be carefully controlled.

The clip should be carefully fitted over the two setscrews furnished. These setscrews thread into the two unused tapped holes in the probe cap.

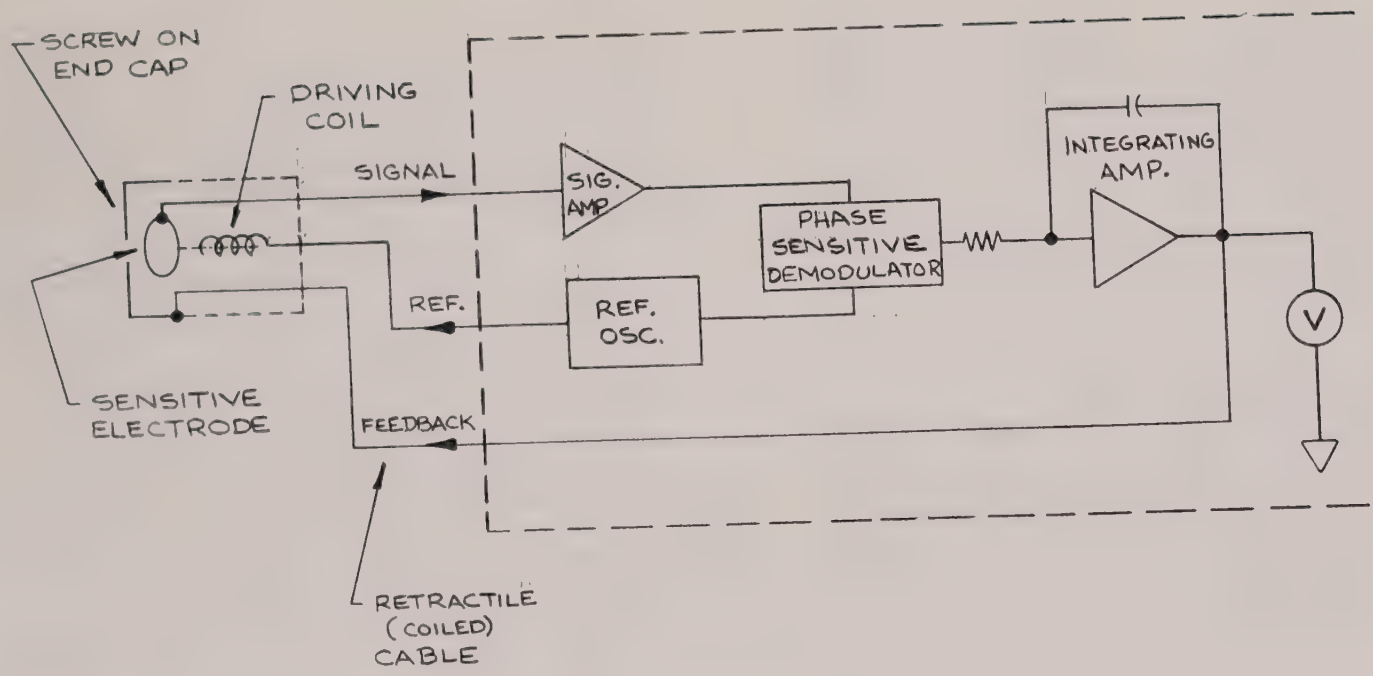
The center of the clip at the point where the aperture is found should bear flat against the face of the cap over as much area as possible.

The setscrews should be tightened only very lightly against the threads in the probe body as these fine threads may be damaged by overtightening.

It is recommended that the setscrews be removed and stored with the clip when the clip is not in use to prevent their loss.

PROBE

METER HOUSING




SIMPLIFIED BLOCK DIAGRAM

DRAWING IV-1

| | | | | | | |
|---|---|---|---|---|---|---|
| | | LOC. LET | REVISIONS | | | DATE |
| | | SCALE | | DATE | MONROE ELECTRONICS, INC. LYNDONVILLE, NEW YORK | |
| | | DRAWN | BWC | 12/22/72 | | |
| | | CH'KD | | | MODEL 230 STAT-ARC | |
| NEXT ASSEMBLY | NO. REQ. | APP'D | | | | |
| TOLERANCE UNLESS OTHERWISE SPECIFIED DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 1° | | | | | 230/12 | |
| MATERIAL | | | | | | |

PRINTED ON NO. 1000H CLEARPRINT

## Section IV

## THEORY

The Model 230B STAT-ARC detects static charge accumulation by measurement of electrostatic field with respect to the essentially grounded probe assembly.

When the probe is brought into proximity with a charges object, either conductive or insulating, and electric field is established between them. This field is proportional to the amount of charge present and the geometry with regard to probe-to-surface distance, and object size and shape. The Model 230B STAT-ARC measures the field using a unique "nulling" technique which can be summarized as follows: (refer to figure IV-1, Simplified Block Diagram).

The vibrating sensitive electrode, "senses" the field through the aperture in the probe housing. The A.C. signal induced on this electrode is proportional to its excursion path length and the strength of the field. The polarity of the field determines phase. This signal and a reference signal from the oscillator are fed into a phase sensitive demodulator whose output feeds a D.C. integrating amplifier. The output of this amplifier is used to drive the probe bottom plate to a potential just sufficient to neutralize the net field at the sensitive electrode. This feedback principle and null-seeking operation make the instrument remarkably stable and highly accurate. Solid state components and integrated circuits are used throughout for reliability.

NOTE:

Although this instrument actually measures electric field (Volts per unit distance) at the probe, the meter is calibrated in terms of volts of surface potential at the measured surface. This calibration technique has been chosen because it is most convenient to the average user; but this type of calibration is very sensitive to geometrical considerations. The Model 230B is factory calibrated using a large, flat metal sheet and the probe suspended outside the meter housing. The calibration would be altered if large grounded objects are near the surface being measured, or if the surface were not essentially flat, or if the surface were not essentially uniformly charged.

In general, these considerations do not present a problem in use, since for for any given geometry, the meter indication will be directly proportional to surface voltage (and charge) and therefore provide excellent accuracy for relative measurements.

For further information concerning electrical field measurements in various geometries refer to:

"The Use Of Electric Field Meters For Precision Measurements" by A. Van Roggen (E.I. DuPont DeNemours And Company, Inc.) presented at the Conference on Electrical Insulation and Dielectric Phenomena, October, 1972.

## Section V

## MAINTENANCE

Normal maintenance for this instrument should be limited to periodic cleaning and battery replacement. Frequencies of cleaning will depend on the cleanliness of the environment in which the instrument is used.

### A. Repairs:

In the event of catastrophic failure, the instrument should be returned to the factory for repair.

Non-Warranty repairs will be made according to the following schedule of charges:

| ITEM NO. | DESCRIPTION | PRICE |
|---|---|---|
| 1. | Probe replacement | $200.00 |
| 2. | Probe cable replacement | 40.00 |
| 3. | Meter replacement | 35.00 |
| 4. | Electrical failure other than probe or meter | 90.00 |
| 5. | Missing or mechanically damaged parts-parts and labor | |
| 6. | Snap-On "X 10" clip | 8.75 |

All prices are F.O.B. Factory, Lyndonville, New York. Prices are subject to change without notice.

### B. Cleaning:

It is impossible for the aperture in the probe housing to be covered by a window of any sort and to continue to operate normally.

So long as this aperture is open, foreign materials may enter the volume associated with the vibrating electrode and generate undesired signals, offset, or drift thereby impairing the accuracy and utility of the instrument. For best performance, therefore, it is necessary to periodically clean the probe.

For routine cleaning, it is easiest to use a spray can of some suitable non-residue producing solvent, for example, Freon® T-P35.* If this technique proves inadequate, it is possible to disassemble the probe for cleaning by removing the two set screws in the probe housing cap and unscrewing it - BEING CAREFUL TO COUNT EXACTLY THE NUMBER OF TURNS REQUIRED TO THE NEAREST 1/16 TURN. Instrument calibration is critically dependent on the setting of this probe housing cap and the set screws must align exactly with the calibration slots in the probe. It is reasonable to mark the set

*Miller-Stephenson Chem. Co., Inc., Danbury, CT 06810. Cat #MS-160.

screw position before loosening, but it is still necessary to count the number of turns required for removal of the cap.

Do not use an abrasive cleaner on any of the probe parts as it may remove part of the plating. It is best to use spray-on solvents, wiping parts only when absolutely necessary. When replacing the probe housing cap, be certain to tighten it to the exact number of turns used to remove it.

After cleaning, allow probe to dry thoroughly and check zero setting and calibration before making measurements.

C. Calibration:

1. Hold Model 230B steadily in its normal operating position (usually horizontal).

2. With instrument OFF turn meter adjusting screw (below center of meter) as required to bring meter needle to exact mid-scale position.

3. Remove probe from barrel (See "Probe Mounting" and "Important Notes", Section III).

4. Fixture Model 230B solidly in its normal operating position.

5. Remove snap-on "X10" clip from probe if so equipped.

6. Remove setscrews from probe cap.

7. Fixture the probe so that it is spaced 1" from a large plane metal surface insulated to at least 5 KV.

   The surface of the probe cap should be as nearly parallel to the test surface as practicable.

8. Ground Model 230B and test surface.

9. Switch Model 230B to X10 range and zero instrument after at least 10-second stabilization period.

10. Apply 5000 volts to test surface and adjust end cap for full scale reading.

11. Return test surface to ground potential and recheck spacing. Adjust to 1" if necessary. Recheck instrument zero.

12. Repeat Steps 10 and 11. until no further changes are noted.

13. Determine which of two adjacent setscrew holes will require the least change in the cap adjustment to allow one of these holes to line up with one of the eight slots in the threaded portion of the probe body and

insert one of the special, turned-down setscrews in this hole. The setscrew should then bottom in the bottom of the slot.

14. Verify that calibration is within ±5%.

15. Insert the other special setscrew in the tapped hole diametrically opposite the first and secure both. Do not overtighten!

16. If "X10" clip is to be used insert the common setscrews in the other two tapped holes so that they bear only lightly on the threaded portion of the probe body.

17. Verify calibration of other ranges if desired.

NOTE: Calibration accuracy is a direct function of calibrating voltage and care taken in fixturing.

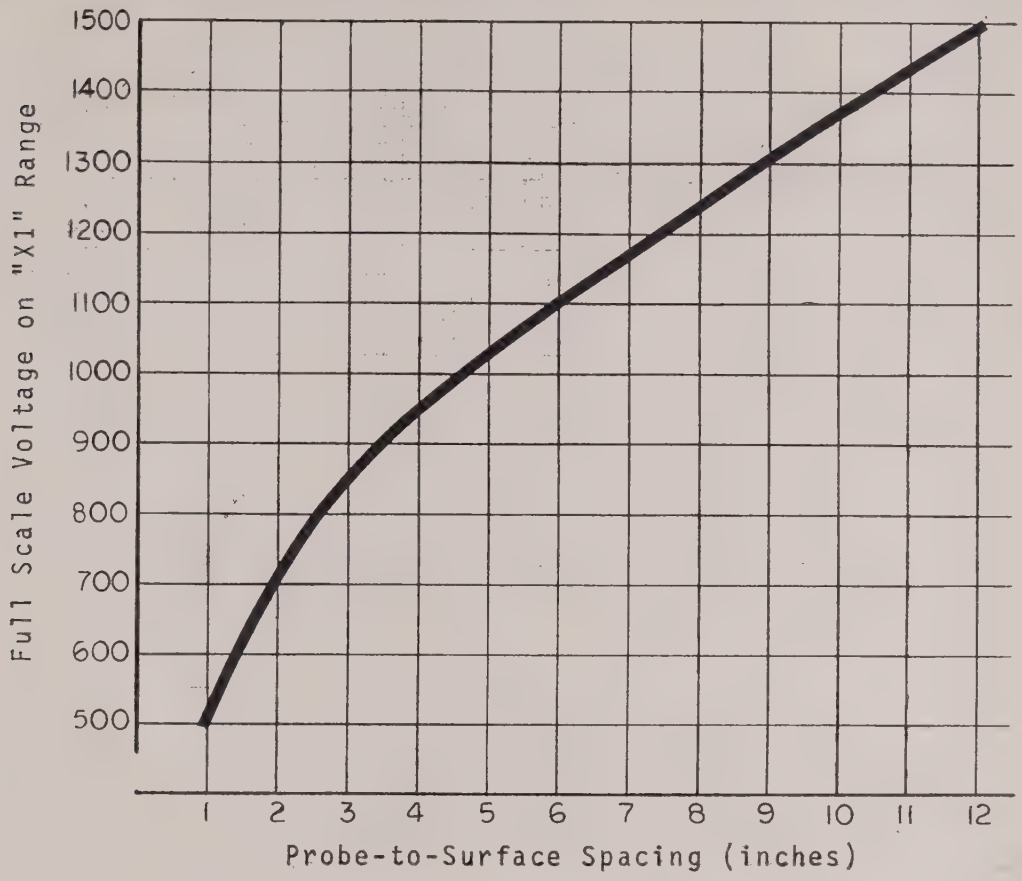
D. Alternate Calibration (for specific geometry):

If the Model 230B and/or probe is to be used in a fixed location with fixed probe-to-surface spacing, e.g., inside a machine as a monitor, it is best calibrated in that location.

The procedure is similar to above except that the surface to be measured must be raised to a known potential in order to perform the calibration.

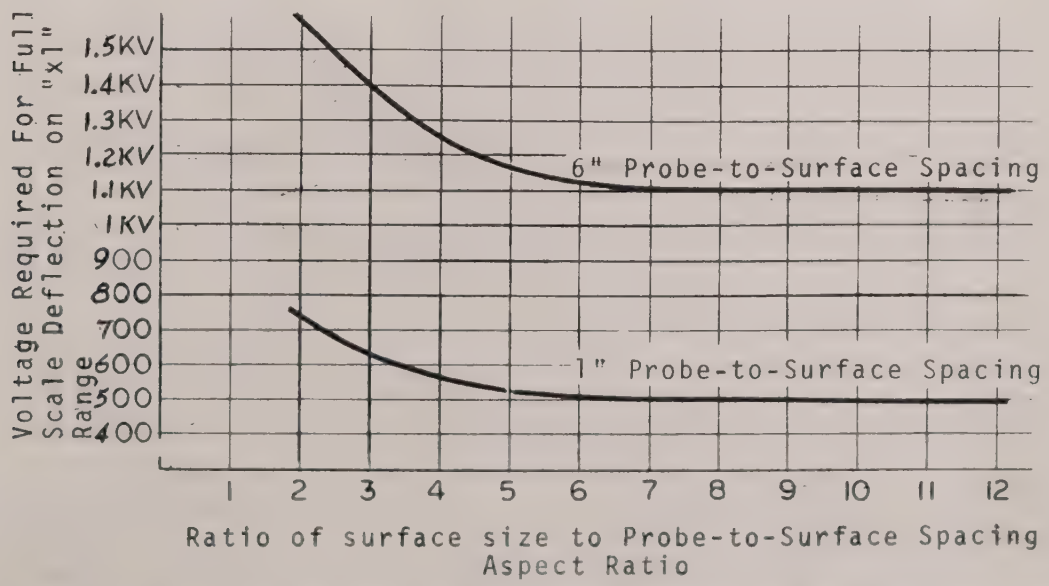
This procedure will better account for field distortion.

A. Calibration at other than 1" or 12" probe-to-surface spacing:




NOTE: Measured data taken using a 72" square metal surface.

B. Calibration vs. Aspect Ratio:




NOTE: Surface "Size" refers to the edge dimension of a square surface.

# MATERIAL LIST

## MODEL 230B HAND HELD FIELDMETER

| Ref No. | Description | Vendor No. |
|---|---|---|
| R102 | Pot, 100K, 10T, .25% Lin. | Beckman 7276 |
| R103 & R104 | Resistor 1K, 1/4W, 5% | AB CB |
| R105 & R106 | " 200K, 1/4W, 5% | AB CB |
| R107 | " 100K, 1/4W, 1% | Electra MF |
| CR101 & CR102 | Diode | GE IN4148 |
| M101 | Meter | M.E. 98015B |
| S102 & S103 | Push Button | Grayhill 39-1 |
| S-101 | Rotary Switch | Grayhill 71B30-01-3-4N |
| | X10 End Cap | M.E. 230B/24 |

# MATERIAL LIST

## MODEL 230B PROBE SUB-ASSEMBLY

| Ref No. | Description | Vendor No. |
|---|---|---|
| R101 | Resistor 10K, 1/4W, 5% | AB CB |
| | Cable, Coiled Microphone | Beldon 8491 |
| | Gradient Cap | M.E. 230B/42 |

# MATERIAL LIST

## MODEL 3089-2 PC BOARD ASSEMBLY

| Ref No. | Description | Vendor No. |
|---|---|---|
| R-1 & R-9 | Resistor, 100K, 1/4W, 5% | AB CB |
| R-2 & R-4 | " 10M, 1/4W, 5% | AB CB |
| R3 | " 1M, 1/4W, 5% | AB CB |
| R-5 & R-6 | " 3.32K, 1/8W, 1% | Electra MF 1/8 |
| R-7, R-8, R-10 | " 100K, 1/8W, 1% | Electra MF 1/8 |
| R-11 | " 1K, 1/8W, 1% | Electra MF 1/8 |
| R-12 | " 150Ω, 1/4W, 5% | AB CB |
| R-13 | " 100Ω, 1/4W, 5% | AB CB |
| R-14 | " 820K, 1/4W, 5% | AB CB |
| R-15 & R-16 | " 499K, 1/8W, 1% | Electra MF 1/8 |
| R-17 | " 240K, 1/4W, 5% | AB CB |
| R-18 | " 1K, 1/4W, 5% | AB CB |
| R-19 | " 9.31K, 1/8W, 1% | Electra, MF 1/8 |
| R-20 | " 29.4K, 1/8W, 1% | Electra, MF 1/8 |
| C1 | Capacitor, 27p | Elmenco DM15-270 |
| C2 | " 330p | Elmenco DM15-331 |
| C3 | " 1μ, 25V | Sprague TE-1200 |
| C4 | " .068μ, 80V | Sprague 192P-6839R8 |
| C5 | " .033μ, 80V | Sprague 192P-3339R8 |
| C6 & C7 | " .022μ, 80V | Sprague 192P-2239R8 |
| C8 | " .22μ, 80V | Sprague 192P-2249R8 |
| C9 | " .1μ, 80V | Sprague 192P-1049R8 |
| C10 & C11 | " 100μ, 10V | Sprague 150D-107x9010R2 |
| CR1 & CR2 | Diode | Syc./TI IN457 |
| CR3, CR4, CR10 &CR11 | " | GE IN4148 |
| CR5 & CR6 | " | N.S. LM329DZ |
| CR7 | " Bridge Rectifier | Varo VE08 |
| CR9 | " Zener | Mot. IN4729 |
| LED/PC-1 | LED/Photo-Conductor | M.E. 90901 |
| A1 | Int. Circuit | NS LM-308H |
| A2, A3 & A4 | " " | Fairchild U5B7741393 |
| T1 | Transformer | Micro-Tran MMT-31-FB |

PREAMP

+9V

R6
3.32K

A-1
LM-308

+9V -9V

CR-3
IN4148

BK

R-1
100K

A-1

CR-4
IN4148

C-1
27P

CR-2
IN457

CR-2
IN457

-9V

R-2
10M

R-3
1M

C-2
330P

R-4
10M

C-5
.033μ

WH

R101
100K

OSCILLATOR

GN

+9V

A-3

CR-7
VE09

C-5
.033μ

LED/PC
CL600

R-12
150Ω

-9V

CR-9
IN4729

R-14
820K

C-4
.068μ

R-13
100Ω

TO S-102

S101A

-9V

B-1
9V

C-10
100μ

B-2
9V

C-11
100μ
10V

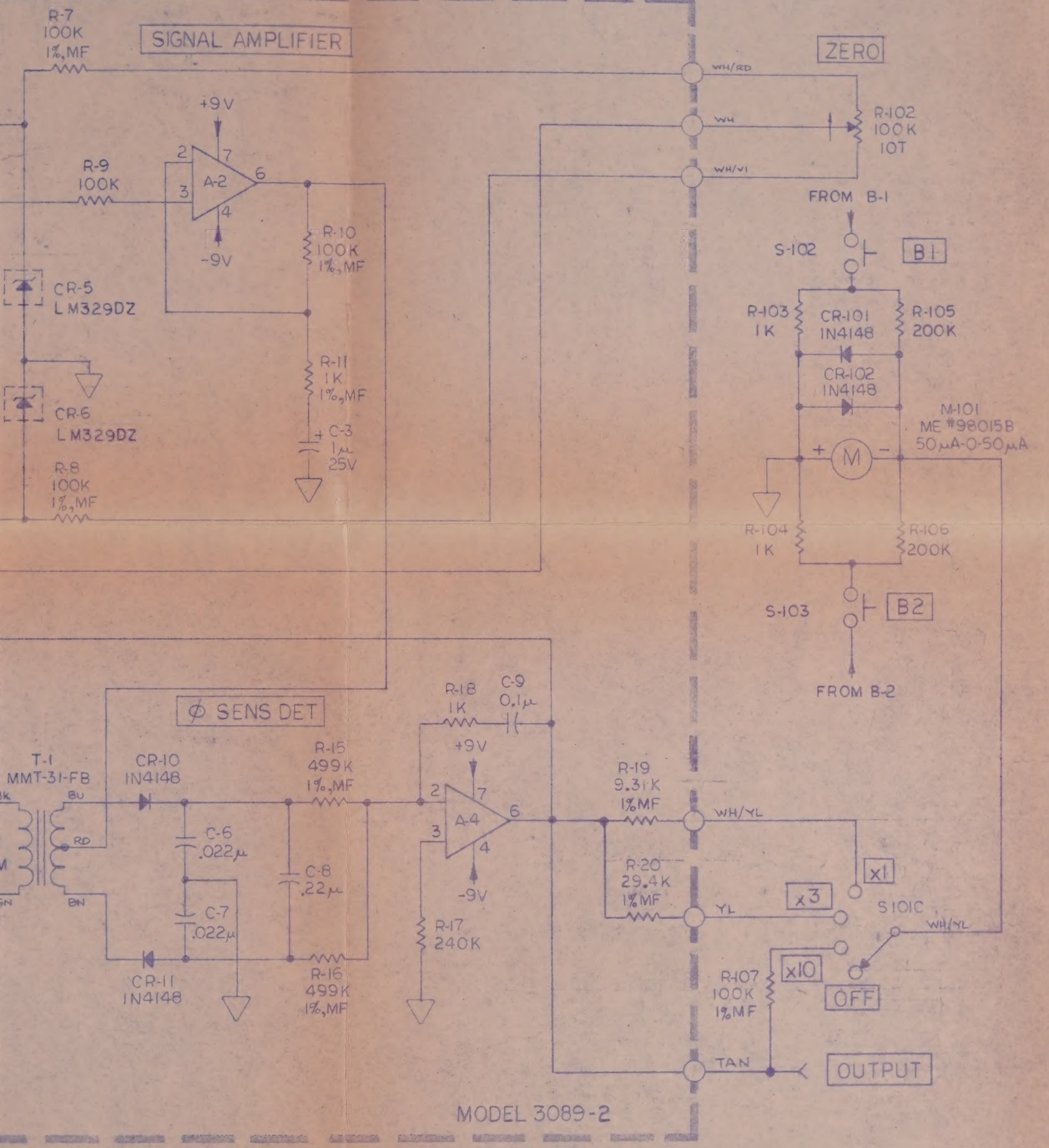
S101B

-9V

TO S-103

NOTE:

1. ALL RESISTO
OTHERWISE
2. A-2, A-3 & A-4
U 5B774139
3. R101 IS LOCA




S ARE ¼W, 5% UNLESS
PECIFIED.
ARE FAIRCHILD

ED ON "OUTPUT" JACK

| | | | |
|---|---|---|---|
| C | R101 WAS 10K FIXED (ECO 1114) | RTV 8-26-82 |
| B | CR5 & CR6 WERE F16HI | MN 12 SEPT 78 |
| A | CR7 WAS W110 | BMC 5-23-77 |

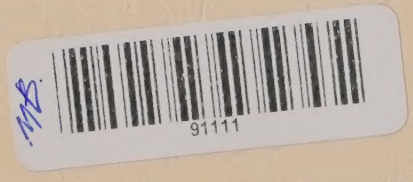
| LOC. | LET. | REVISIONS | DATE |
|---|---|---|---|

| | | | | | |
|---|---|---|---|---|---|
| | | SCALE | ~ | DATE | MONROE ELECTRONICS, Inc. MIDDLEPORT, N. Y. |
| | | DRAWN | BMC | 31 DEC 74 | |
| | | CH'KD. | JPA | 1/3/75 | MODEL 230B HAND HELD FIELDMETER |
| NEXT ASSEMBLY | NO. REQ. | APP'D | | | |

TOLERANCE UNLESS OTHERWISE SPECIFIED:
DECIMAL ± .005 FRACTIONAL ± 1/64 ANGULAR ± 15'
MATERIAL

230B/1

230B/1


91111